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Biliary Tract Complications in Orthotopic Adult Liver Transplantation

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In a series of orthotopic liver transplantations performed between April and August 1987 at the University of Pittsburgh, the monofilament absorbable suture polyglyconate was compared with a braided absorbable suture, polyglactin 910, for its biliary complication rate over a 6-month postoperative period. Complications that were suture-related (obstruction or leak from the anastomotic site) occurred in 1 of 21 transplantations in the polyglyconate group compared with 8 of 26 in the polyglactin 910 group ($p = 0.02$). Even though the patient sample was relatively small, it appears that the type of suture used for the biliary anastomosis directly correlates with the outcome. A larger patient trial could confirm these initial results.

In the early era of liver transplantation, the biliary anastomosis was considered the operative Achilles heel. Over the past 25 years, however, the biliary drainage procedure has now been well refined, and advances other than technical seemed the next logical avenue of pursuit. Specifically, could the choice of suture material used for this anastomosis further lower the rate of biliary complications? To test this hypothesis, a new monofilament absorbable suture (polyglyconate) was compared with the standard suture in use at the University of Pittsburgh (polyglactin 910) for the biliary anastomosis. The purpose of the study was to determine if the type of suture used for the biliary tract reconstruction after liver transplantation would influence the incidence and type of complication seen.

MATERIAL AND METHODS

Beginning in April 1987, 50 consecutive cases of liver transplantation in adults were to be randomly assigned by a computer-generated code to have the biliary anastomosis performed with either polyglyconate or polyglactin 910. The type (Roux-Y versus choledochocholedochostomy) and technique (running versus interrupted suture placement) of the anastomosis was dictated by patient disease, size of the bile duct, and surgeon preference. Upon completion of the case, a case report record was filled out by the operating surgeon and the patients were followed both on an inpatient and outpatient basis. A 6-month follow-up was mandatory for inclusion in the study to provide adequate time for suture-related complications to occur. Any patient who died within the 6-month period was excluded, unless the death was caused by a biliary complication. Patients who died while the study was still in progress were replaced.

All patients who had a choledochocholedochostomy had a T tube in place for a minimum of 3 months. These patients were routinely evaluated at least twice by cholangiogram, before the T tube was clamped, and again before the T tube was removed at 3 months. In addition, cholangiograms were obtained for any suspicion of a biliary complication. Patients with a Roux-Y choledochojejunostomy did not have external access to the biliary tree; therefore, routine studies which would have required an invasive procedure were not performed. These patients (13 of 24 or 54.2 percent) were evaluated by percutaneous transhepatic cholangiogram if there was any clinical or laboratory suspicion of a biliary complication. If a stricture was found and was suitable for radiologic dilatation, this method was attempted first [1]. If the stricture could not be radiologically dilated or if a leak was present, surgical correction was required.

Transplantation in these patients was performed for a variety of liver disorders including primary biliary cirrhosis, sclerosing cholangitis, refractory rejection, Laënnec's cirrhosis, alpha$_1$-antitrypsin disease, chronic active hepatitis, hepatoma, and autoimmune cryptogenic cirrhosis.

Statistical analyses (chi-square) were calculated using the statistical analysis modules in SPSS on an Everex System 1800 microcomputer.

RESULTS

Fifty-nine patients were actually entered into the study; 9 patients died while the study was still in progress. Twenty-eight patients underwent biliary anastomosis with polyglyconate; of these, 7 died and were excluded from the study (2 from primary nonfunction of the graft, 1 from recurrent hepatoma, 1 from rejection, 1 from vascular anastomosis technical failure, and 2 from cytomegaloviral infection). Of the 21 patients followed,

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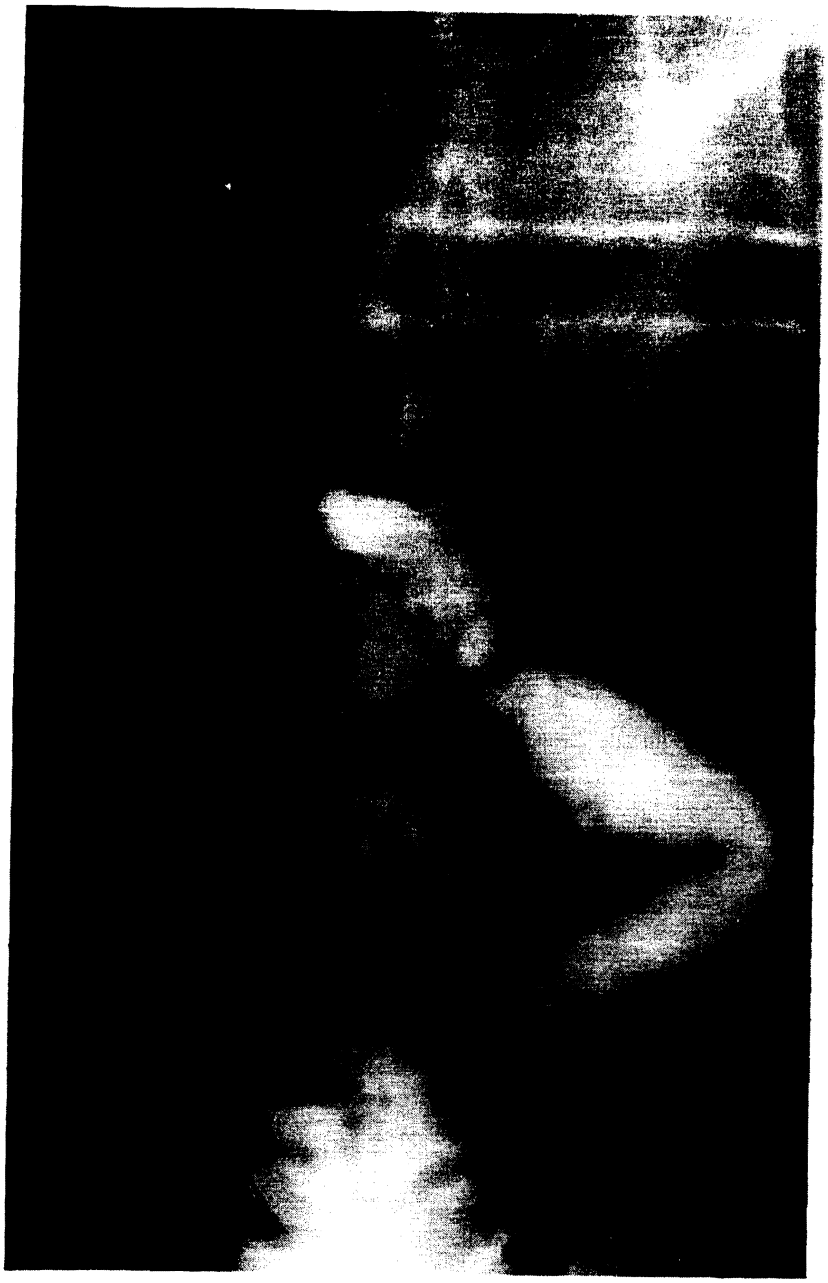

Figure 1. Ampullary dysfunction. Top arrow indicates native common hepatic duct, middle arrow indicates dilated native cystic duct, and bottom arrow indicates donor common bile duct.

underwent choledocholedochostomy and 9 underwent Roux-Y choledochojejunostomy.

Thirty-one patients underwent anastomosis with polyglactin 910. Seven of these patients died; five were excluded from the study (one died from recurrent hepatoma, one from rejection, one from hepatitis B, one from bacterial infection, and one died in the operating room) and two were included (one from recurrent gastrinoma more than 6 months postoperatively, one from sepsis from a biliary leak).

There were four biliary complications in the polyglyconate group versus eight biliary complications in the polyglactin 910 group. The complications could be divided into nonanastomotic, that is, ampullary dysfunction (Figure 1) or anastomotic. Of the four complications in the polyglyconate group, three were nonanastomotic problems and thus could not be related to the suture material. The first patient had been reconstructed with a choledochojejunostomy and developed a stricture of the bifurcation of the common hepatic ducts (high above the anastomosis) successfully dilated by the radiologist. The second patient had been reconstructed with a choledochocholedochostomy and developed uniform dilatation of the entire biliary system secondary to a stenosis at the ampulla of Vater. This anastomosis was converted to a Roux-Y choledochojejunostomy. The third patient was reconstructed with a choledochocholedochostomy. Postoperatively, the patient became disoriented and pulled out the T tube; he was converted to a Roux-Y choledochojejunostomy. The fourth patient had been reconstructed with a

choledochocholedochostomy and developed an anastomotic stricture which required conversion to a Roux-Y choledochojejunostomy.

There were eight anastomotic complications in the polyglactin 910 group; four with choledochocholedochostomy reconstructions (two successfully dilated, two converted to Roux-Y choledochojejunostomies) and four with Roux-Y choledochojejunostomies (two were successfully dilated, one had a revision of the choledochojejunostomy, and one patient died secondary to sepsis after a biliary leak at the anastomosis). All complications involved the anastomosis and thus could be potentially related to the suture material.

The possible suture-dependent complications for polyglyconate and polyglactin 910 were compared using the chi-square test. The difference in complication rate was statistically significant ($p = 0.0243$), with polyglyconate giving superior results.

COMMENTS

Improvement in the survival rate for liver transplantation since 1963 has been largely due to improvements in immunosuppressive drugs (cyclosporine) and refinements in the technique of the bilary tract reconstruction [*2*]. Failure of the biliary anastomosis has been demonstrated to occur early after transplantation as a result of rejection, hepatic artery thrombosis, stricture, leak, or infection [*3*]. Due to an evolution in the understanding of the biliary tract vascular anatomy and physiology, and to the development of diagnostic radiologic methods for early identification and treatment of biliary complications, this complication rate has dropped to 10 to 15 percent from 50 percent in the early series [*4*]. In May 1986, the University of Pittsburgh reported results of 393 consecutive orthotopic liver transplants in 313 patients. There were 52 biliary tract complications (13.2 percent) with 5 directly related deaths [*4*].

Improvements in suture development have led to the availability of synthetic absorbable sutures which have a reproducible absorption rate not influenced by wound conditions (inflammation or infection) or body fluids [*5,6*]. In contrast to animal-matter suture material, synthetic absorbable sutures undergo nonenzymatic hydrolysis, thereby generating less inflammatory reaction than the enzymatic phagocytosis of surgical gut [*5,6*].

Prior to the availability of the new monofilament suture polyglyconate, the suture used for the biliary anastomosis at the University of Pittsburgh had been polyglactin 910, a braided absorbable material. Experimental studies have shown that braided material can significantly increase the wound infection rate [*7*]. The mechanism by which this occurs has been attributed to bacterial adherence to the braided suture. Bacterial adherence of braided suture is 5 to 8 times that of monofilament nylon and correlates with the incidence of infection [*8–10*].

Polyglyconate is a synthetic monofilament suture, a copolymer consisting of glycolic acid and trimethylene carbonate. It is completely absorbed by nonenzymatic hydrolysis and is essentially absorbed in 180 days and completely absorbed in 210 days. It maintains 70 percent of its original tensile strength after 2 weeks and 55 percent of its strength after 3 weeks [*7*].

Coated polyglactin 910 is a braided synthetic, absorbable suture. It is composed of polyglactin 910 which is 90 percent polyglycolic acid and 10 percent lactic acid. It, too, is absorbed by nonenzymatic hydrolysis, being essentially absorbed between 60 and 90 days. It maintains 55 percent of its original tensile strength at 2 weeks and 20 percent at 3 weeks.

This study of biliary anastomotic complications using monofilament polyglyconate versus braided polyglactin 910 in transplant patients who have compromised wound healing secondary to immunosuppression demonstrated the superiority of polyglyconate. Transplant patients, as a rule, typify the most extreme population of patients upon whom trials of this sort are performed; these patients are immunosuppressed, often malnourished and very catabolic, and many have had multiple previous surgeries. The fact that there was a significant difference between the complication rate for each suture in this small series of patients suggests that polyglyconate would also be of benefit in the nonimmunosuppressed patient undergoing biliary tract surgery.

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